Indiana's academic standards for science contain six standards. Each standard is described below. On the pages that follow, age-appropriate concepts are listed underneath each standard. These ideas build a foundation for understanding the intent of each standard.

Standard 1 — The Nature of Science and Technology

It is the union of science and technology that forms the scientific endeavor and that makes it so successful. Although each of these human enterprises has a character and history of its own, each is dependent on and reinforces the other. This first standard draws portraits of science and technology that emphasize their roles in the scientific endeavor and reveal some of the similarities and connections between them. In order for students to truly understand the nature of science and technology, they must model the process of scientific investigation through inquiries, fieldwork, lab work, etc. Through these experiences, students will practice designing investigations and experiments, making observations, and formulating theories based on evidence.

Standard 2 — Scientific Thinking

There are certain thinking skills associated with science, mathematics, and technology that young people need to develop during their school years. These are mostly, but not exclusively, mathematical and logical skills that are essential tools for both formal and informal learning and for a lifetime of participation in society as a whole. Good communication is also essential in order to both receive and disseminate information and to understand others' ideas as well as have one's own ideas understood. Writing, in the form of journals, essays, lab reports, procedural summaries, etc., should be an integral component of students' experiences in science.

Standard 3 — The Physical Setting

One of the grand success stories of science is the unification of the physical universe. It turns out that all natural objects, events, and processes are connected to each other. This standard contains recommendations for basic knowledge about the overall structure of the universe and the physical principles on which it seems to run, with emphasis on Earth and the solar system. This standard focuses on two principle subjects: the structure of the universe and the major processes that have shaped planet Earth, and the concepts with which science describes the physical world in general – organized under the headings of *Matter and Energy* and *Forces of Nature*. In Grade 5, students continue to learn about changes to Earth and the sky. They learn about the properties of materials and how those properties can change.

Standard 4 — The Living Environment

People have long been curious about living things – how many different species there are, what they are like, how they relate to each other, and how they behave. Living organisms are made of the same components as all other matter, involve the same kinds of transformations of energy, and move using the same basic kinds of forces. Thus, all of the physical principles discussed in Standard 3 – The Physical Setting, apply to life as well as to stars, raindrops, and television sets. This standard offers recommendations on basic knowledge about how living things function and how they interact with one another and their environment. In Grade 5, students learn that organisms are composed of collections of similar cells and that these cells benefit from cooperating. They learn that characteristics of organisms, as well as their environment, affect survival.

Standard 5 — The Mathematical World

Mathematics is essentially a process of thinking that involves building and applying abstract, logically connected networks of ideas. These ideas often arise from the need to solve problems in science, technology, and everyday life — problems ranging from how to model certain aspects of a complex scientific problem to how to balance a checkbook.

Standard 6 — Common Themes

Some important themes pervade science, mathematics, and technology and appear over and over again, whether we are looking at ancient civilization, the human body, or a comet. These ideas transcend disciplinary boundaries and prove fruitful in explanation, in theory, in observation, and in design. A focus on *Constancy and Change* within this standard provides students opportunities to engage in long-term and on-going laboratory and fieldwork, and thus understand the role of change over time in studying The Physical Setting and The Living Environment.

Standard 1

The Nature of Science and Technology

Students work collaboratively to carry out investigations. They observe and make accurate measurements, increase their use of tools and instruments, record data in journals, and communicate results through chart, graph, written, and verbal forms. Students repeat investigations, explain inconsistencies, and design projects.

The Scientific View of the World

5.1.1 Recognize and describe that results of similar scientific investigations may turn out differently because of inconsistencies in methods, materials, and observations*.

* observation: gaining information through the use of one or more of the senses, such as sight, smell, etc.

Scientific Inquiry

5.1.2 Begin to evaluate the validity of claims based on the amount and quality of the evidence cited.

The Scientific Enterprise

5.1.3 Explain that doing science involves many different kinds of work and engages men, women, and children of all ages and backgrounds.

Technology and Science

5.1.4 Give examples of technology, such as telescopes, microscopes, and cameras, that enable scientists and others to observe things that are too small or too far away to be seen without them and to study the motion of objects that are moving very rapidly or are hardly moving.

5.1.5 Explain that technology extends the ability of people to make positive and/or negative changes in the world.

5.1.6 Explain how the solution to one problem, such as the use of pesticides in agriculture or the use of dumps for waste disposal, may create other problems.

5.1.7 Give examples of materials not present in nature, such as cloth, plastic, and concrete, that have become available because of science and technology.

Standard 2

Scientific Thinking

Students use a variety of skills and techniques when attempting to answer questions and solve problems. Students describe their observations accurately and clearly using numbers, words, and sketches, and are able to communicate their thinking to others. They compare, contrast, explain, and justify both information and numerical functions.

Computation and Estimation

5.2.1 Multiply and divide whole numbers* mentally, on paper, and with a calculator.

5.2.2 Use appropriate fractions and decimals when solving problems.

* whole number: 0, 1, 2, 3, etc.

Manipulation and Observation

5.2.3 Choose appropriate common materials for making simple mechanical constructions and repairing things.

5.2.4 Keep a notebook to record observations and be able to distinguish inferences* from actual observations.

5.2.5 Use technology, such as calculators or spreadsheets, in determining area and volume from linear dimensions. Find area*, volume*, mass*, time, and cost, and find the difference between two quantities of anything.

* inference: a train of logic based on observations, leading to an explanation
* area: a measure of the size of a two-dimensional region
* volume: a measure of the size of a three-dimensional object
* mass: a measure of how much matter* is in an object
* matter: anything that has mass and takes up space

Communication Skills

5.2.6 Write instructions that others can follow in carrying out a procedure.

5.2.7 Read and follow step-by-step instructions when learning new procedures.

Critical Response Skills

5.2.8 Recognize when and describe that comparisons might not be accurate because some of the conditions are not kept the same.

Standard 3

The Physical Setting

Students continue to investigate changes of Earth and the sky. They explore, describe, and classify materials, motion, and energy*.*

The Universe

5.3.1 Explain that telescopes are used to magnify distant objects in the sky, including the moon and the planets.

5.3.2 Observe and describe that stars are like the sun, some being smaller and some being larger, but they are so far away that they look like points of light.

5.3.3 Observe the stars and identify stars that are unusually bright and those that have unusual colors, such as reddish or bluish.

* motion: the change in position of an object in a certain amount of time
* energy: what is needed to make things move

Earth and the Processes That Shape It

5.3.4 Investigate that when liquid water disappears it turns into a gas* (vapor) mixed into the air and can reappear as a liquid* when cooled or as a solid* if cooled below the freezing point of water.

5.3.5 Observe and explain that clouds and fog are made of tiny droplets of water.

5.3.6 Demonstrate that things on or near Earth are pulled toward it by Earth's gravity*.

5.3.7 Describe that, like all planets and stars, Earth is approximately spherical in shape.

* gas: matter with no definite shape or volume
* liquid: matter with no definite shape but with a definite volume
* solid: matter with a definite shape and volume
* gravity: a force that pulls or attracts objects toward one another

Matter and Energy

5.3.8 Investigate, observe, and describe that heating and cooling cause changes in the properties of materials, such as water turning into steam by boiling and water turning into ice by freezing. Notice that many kinds of changes occur faster at higher temperatures*.

5.3.9 Investigate, observe, and describe that when warmer things are put with cooler ones, the warm ones lose heat* and the cool ones gain it until they are all at the same temperature. Demonstrate that a warmer object can warm a cooler one by contact or at a distance.

5.3.10 Investigate that some materials conduct* heat much better than others, and poor conductors can reduce heat loss.

* temperature: a measure of average heat energy that can be measured using a thermometer
* heat: a form of energy characterized by random motion at the molecular level
* conduction: the movement of heat through matter

Forces of Nature

5.3.11 Investigate and describe that changes in speed* or direction of motion of an object are caused by forces*. Understand that the greater the force, the greater the change in motion and the more massive an object, the less effect a given force will have.

5.3.12 Explain that objects move at different rates, with some moving very slowly and some moving too quickly for people to see them.

5.3.13 Demonstrate that Earth's gravity pulls any object toward it without touching it.

* speed: the rate per unit time at which an object moves
* force: a push or a pull that can cause a change in the motion* of an object
* motion: the change in position of an object in a certain amount of time

Standard 4

The Living Environment

Students learn about an increasing variety of organisms – familiar, exotic, fossil, and microscopic. They use appropriate tools in identifying similarities and differences among these organisms. Students explore how organisms satisfy their needs in their environments.

Diversity of Life

5.4.1 Explain that for offspring to resemble their parents there must be a reliable way to transfer information from one generation to the next.

5.4.2 Observe and describe that some living things consist of a single cell that needs food, water, air, a way to dispose of waste, and an environment in which to live.

5.4.3 Observe and explain that some organisms are made of a collection of similar cells that benefit from cooperating. Explain that some organisms' cells, such as human nerve and muscle cells, vary greatly in appearance and perform very different roles in the organism.

Interdependence of Life and Evolution

5.4.4 Explain that in any particular environment, some kinds of plants and animals survive well, some do not survive as well, and some cannot survive at all.

5.4.5 Explain how changes in an organism's habitat are sometimes beneficial and sometimes harmful.

5.4.6 Recognize and explain that most microorganisms do not cause disease and many are beneficial.

5.4.7 Explain that living things, such as plants and animals, differ in their characteristics, and that sometimes these differences can give members of these groups (plants and animals) an advantage in surviving and reproducing.

5.4.8 Observe that and describe how fossils can be compared to one another and to living organisms according to their similarities and differences.

Human Identity

5.4.9 Explain that like other animals, human beings have body systems.

Standard 5

The Mathematical World

Students apply mathematics in scientific contexts. They make more precise and varied measurements in gathering data. Their geometric descriptions of objects are comprehensive, and their graphing demonstrates specific connections. They identify questions that can be answered by data distribution, e.g., "Where is the middle?" and their support of claims or answers with reasons and analogies becomes important.

Numbers

5.5.1 Make precise and varied measurements and specify the appropriate units.

Shapes and Symbolic Relationships

5.5.2 Show that mathematical statements using symbols may be true only when the symbols are replaced by certain numbers.

5.5.3 Classify objects in terms of simple figures and solids.

5.5.4 Compare shapes in terms of concepts, such as parallel and perpendicular, congruence*, and symmetry.

5.5.5 Demonstrate that areas of irregular shapes can be found by dividing them into squares and triangles.

5.5.6 Describe and use drawings to show shapes and compare locations of things very different in size.

* congruent: the term to describe two figures that are the same size and shape

Reasoning and Uncertainty

5.5.7 Explain that predictions can be based on what is known about the past, assuming that conditions are similar.

5.5.8 Realize and explain that predictions may be more accurate if they are based on large collections of objects or events.

5.5.9 Show how spreading data out on a number line helps to see what the extremes are, where they pile up, and where the gaps are.

5.5.10 Explain the danger in using only a portion of the data collected to describe the whole.

Standard 6

Common Themes

Students work with an increasing variety of systems and begin to modify parts in systems and models and notice the changes that result.

Systems

5.6.1 Recognize and describe that systems contain objects as well as processes that interact with each other.

Models and Scale

5.6.2 Demonstrate how geometric figures, number sequences, graphs, diagrams, sketches, number lines, maps, and stories can be used to represent objects, events, and processes in the real world, although such representation can never be exact in every detail.

5.6.3 Recognize and describe that almost anything has limits on how big or small it can be.

Constancy and Change

5.6.4 Investigate, observe, and describe that things change in steady, repetitive, or irregular ways, such as toy cars continuing in the same direction and air temperature reaching a high or low value. Note that the best way to tell which kinds of changes are happening is to make a table or a graph of measurements.